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REMARKS

Claims 1-4, 11-16 and 20-23 are all the claims presently pending in this application. Claims 1-4 and 11-16 have been amended to more particularly define the claimed invention. Claims 5-10 and 17-19 have been canceled.

It is noted that the amendments are made only to more particularly define the invention and not for distinguishing the invention over the prior art, for narrowing the scope of the claims, or for any reason related to a statutory requirement for patentability. It is further noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

Claim 13 stands rejected under 35 U.S.C. §102(b) as being anticipated by Kamihira, U.S. Pat. Pub. No. 2002/0045958.

Claims 1-3, 5, 7, 9, 11-12 and 14-15 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kamihira, U.S. Pat. Pub. No. 2002/0045958 further in view of Mehrotra, "Elements of Artificial Neural Networks".

Claims 4, 6 and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kamihira, U.S. Pat. Pub. No. 2002/0045958 and Mehrotra, "Elements of Artificial Neural Networks" further in view of Fujita, U.S. Pat. Pub. No. 2002/0158599.

Claim 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Kamihira, U.S. Pat. Pub. No. 2002/0045958 and Mehrotra, "Elements of Artificial Neural Networks" further in view of Kimoto, U.S. Patent No. 5,579,442 and Minowa, U.S. Patent No. 6,397,140.

Claims 16-18 stand rejected under 35 U.S.C. §103(a) as being unpatentable over

Kamihira, U.S. Pat. Pub. No. 2002/0045958 further in view of Kimoto, U.S. Patent No. 5,579,442.

Claim 19 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Kamihira, U.S. Pat. Pub. No. 2002/0045958 and Kimoto, U.S. Patent No. 5,579,442, further in view of Minowa, U.S. Patent No. 6,397,140.

These rejections are respectfully traversed in view of the following discussion.

I. APPLICANT'S CLAIMED INVENTION

The claimed invention (as defined, for example, by independent claim 1) is directed to a vehicle motion model generating device for generating a vehicle motion model that represents a motion state of a vehicle, including, a first recurrent neural network formed by connecting plural nodes such that an output of a node is input to another node in accordance with a predetermined coupling weight coefficient, including a feedback loop of an output of at least one node, and outputting a vehicle parameter indicating the motion state of the vehicle based on predetermined input information, thereby functioning as the vehicle motion model.

The invention also includes plural second recurrent neural networks, each of the second recurrent neural networks formed by connecting second plural nodes such that a second output of a second node is input to another second node in accordance with a second predetermined coupling weight coefficient, including a second feedback loop of a second output of at least one second node, and outputting a second vehicle parameter different from the vehicle parameter output from the first recurrent neural network and indicating the motion state of the vehicle based on the predetermined input information, thereby functioning as the vehicle motion model.

Furthermore, the invention includes an optimizing unit for determining an optimum solution of the predetermined coupling weight coefficient of the first recurrent neural network and the second predetermined coupling weight coefficient of the plural second recurrent neural networks based on a learning rule using a hereditary algorithm, wherein the first recurrent neural network and the plural second recurrent neural networks are mutually connected to each other such that a state variable including a correlation with the vehicle parameter output from the first recurrent neural network is input to each of the plural second recurrent neural networks.

Conventionally, in the neural network, adjustment (or learning) of the coupling weight coefficient is carried out in advance according to an algorithm such as back propagation so that the output corresponds to a teaching signal. (Specification at page 3, lines 5-8.)

Additionally, when a vehicle motion model is set, a motion equation is linearly approximated to avoid cumbersome operation processing in the solution calculating process. Therefore, the vehicle motion model may not accurately represent the motion state of the vehicle, that is, the behavior of the vehicle in a non-linear region. (Specification at page 3, lines 10-15.)

Furthermore, in a feed-forward type neural network is used, the value output from the neural network and the value input to the neural network are independent of each other. Thus, the motion state of the vehicle may not be accurately represented in such a neural network. In particular, the values output from the neural network are varied in accordance with not only the input, but also the value thereof at the present time (a present value). Consequently, it is necessary to feed back the output value and reflect the output value to the neural network, in order to estimate the motion state of the vehicle with high precision.

However, the neural network having such feedback has a problem that the coupling weight coefficient cannot be learned according to the principle of a learning rule such as back propagation. Thus, accurate estimation of the road surface friction coefficient is hardly achieved. (Specification at page 3, line 16 to page 4, line 11.)

The claimed invention (e.g., as recited in claims 1 and 11-13), on the other hand, includes *plural second recurrent neural networks, each of the second recurrent neural networks formed by connecting second plural nodes such that a second output of a second node is input to another second node in accordance with a second predetermined coupling weight coefficient, including a second feedback loop of a second output of at least one second node, and outputting a second vehicle parameter different from the vehicle parameter output from the first recurrent neural network and indicating the motion state of the vehicle based on the predetermined input information, thereby functioning as the vehicle motion model, wherein the first recurrent neural network and the plural second recurrent neural networks are mutually connected to each other such that a state variable including a correlation with the vehicle parameter output from the first recurrent neural network is input to each of the plural second recurrent neural networks*.

These features of Applicant's claimed invention are important is to provide a method of creating a motion model of a vehicle by using a recurrent neural network containing a feedback loop to more accurately estimate the road surface coefficient and vehicle motion parameters, (Specification at page 4, lines 6-21.)

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II. THE ALLEGED PRIOR ART REJECTIONS

A. 35 U.S.C. § 102(b) Rejection over Kamihira, U.S. Pat. Pub. No. 2002/0045958

The Examiner alleges that Kamihira, U.S. Pat. Pub. No. 2002/0045958, (Kamihira), teaches the invention of claim 13.

Applicant submits, however, that Kamihira does not teach or suggest:

"*<u>a method for generating a vehicle motion model that represents a motion state of a vehicle</u>, ... <u>plural second recurrent neural networks each formed by connecting the second plural nodes such that a second output of a second node is input to another second note in accordance with a second predetermined coupling wake coefficient</u> and includes a second feedback loop of a second output of at least one second node,*

determining an optimum solution of a genetic type based on a learning rule using a hereditary algorithm <u>while setting said predetermined coupling weight coefficient of said first recurrent neural network and said second predetermined coupling weight coefficient of said plurality of second recurrent neural networks as said genetic type;</u>

<u>outputting a second optimum solution of said second predetermined coupling weight coefficient to said plurality of second recurrent neural networks based on said optimum solution of said genetic type;</u>

outputting a first vehicle parameter from said first recurrent neural network <u>indicating said motion state of the vehicle</u> based on predetermined input information, and <u>outputting at least one second vehicle parameter from said plurality of second recurrent neural networks indicating said motion state of the vehicle based on said predetermined input information</u>, thereby functioning as said vehicle motion model; and

outputting a state variable from said first recurrent neural network to each of said plural second recurrent neural networks, said state variable including a correlation with said first vehicle parameter."

In Fig. 1 of Applicant's invention, the first recurrent neural network corresponds to a yaw rate estimating module 21, and the plural second recurrent neural network corresponds to lateral G estimating module 22, roll estimating module 23, and pitch estimating module 24, respectively.

In Fig. 1 four modules 21 to 24 input to a steering angle, a steering angular velocity, a steering angular acceleration, a steering action force, a vehicle speed, and the vehicle acceleration, as the predetermined input information.

In Fig. 1, the module 21 as the first recurrent neural network outputs the static variable P. The static variable P is input to the modules 22-24 as the second recurrent neural networks. This relation means parallel feedback of the state P as shown below in an exemplary Fig. (A). Claims 1 and 11-13 clearly exclude serial feedback as shown in Fig. (B), below. .

Fig. (A) Parallel Feedback

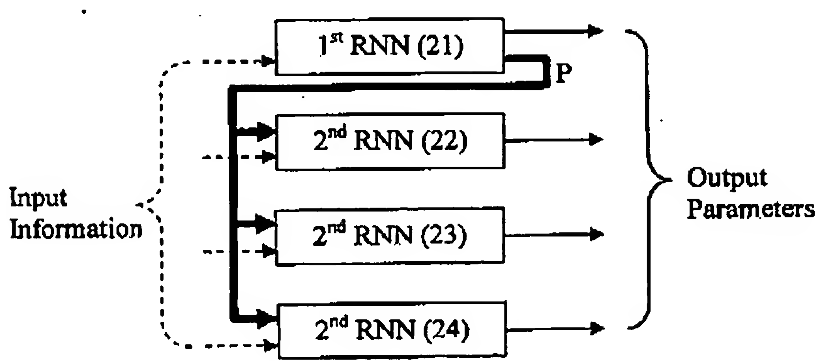
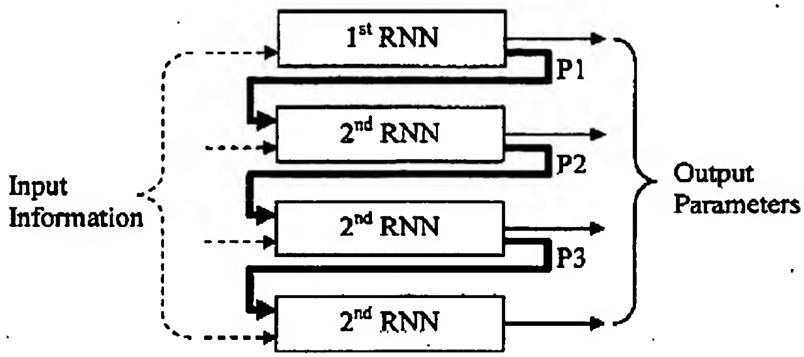


Fig. (B) Serial Feedback



According to Applicant's parallel connection of exemplary Fig. (A), it is possible to control all RNNs synchronously. This effect is described in the specification in detail at page 24, line 9 to page 26, line 5. On the other hand, such effect is not obtained effectively in the serial feedback connection as in Fig. (B), above, because it happens to delay the transfer of the state variable due to its cascading connection. Additionally, at least three RNNs to form the parallel feedback may be employed to accurately produce the output parameters.

Kamihira fails to teach or suggest, *a first recurrent neural network formed by connecting plural nodes such that an output of a node is input to another node in accordance with a predetermined coupling weight coefficient and includes a feedback loop of an output of at least one node, and plural second recurrent neural networks each formed by connecting the second plural nodes such that a second output of a second node is input to another second note in accordance with a second predetermined coupling wake coefficient*

Kamihira teaches a two alternate loops on the same network of devices, not *a first recurrent neural network* and *plural second recurrent neural networks*.

> A machine 1 is manipulated by a user 6 using a control module 2 via an interface 4. Performance of the machine 1 is controlled essentially by the control module 2 having an input-output relationship regulated by control

> parameters. Initial values of the control parameters can be pre-selected, and the machine 1 is activated with the initial values. The performance of the machine 1 is evaluated by the user 6. This feedback loop (the user 6→the interface 4→the control module 2→the machine 1→the user 6) is found in conventional operation. ... This second loop (the machine 1→the user 6←→the interface 5←→the parameter module 3→the control module 2→the machine 1) allows the user 6 to customize the control module in real time. (Emphasis added. Paragraph [0032].)

Furthermore, Kamihira fails to teach or suggest, "*outputting a second optimum solution of said second predetermined coupling weight coefficient to said plurality of second recurrent neural networks based on said optimum solution of said genetic type*," since Kamihira fails to teach or suggest *a plurality of second recurrent neural networks*.

Additionally, Kamihira fails to teach or suggest, "outputting a state variable from said first recurrent neural network to each of said plural second recurrent neural networks, said state variable including a correlation with said first vehicle parameter," since Kamihira fails to teach suggest *a plurality of second recurrent neural networks*.

Further, Applicant respectfully traverses the Examiner's allegation that Applicant's *vehicle motion* is equivalent to controlling a vehicle engine of Kamihira, since there is no teaching or suggestion in Kamihira that controlling a vehicle engine is equivalent to *a method for generating, by a computer, a vehicle motion model that represents a motion state of a vehicle*. Kamihira states:

> [0038] With reference to FIGS. 2 to 13, an apparatus for customizing overall characteristics that is applied for controlling a vehicle engine will be described. (Emphasis added.)

Since Kamihira fails to teach or suggest *a vehicle motion model*, but rather an engine control system, Kamihira fails to teach or suggest *outputting a parameter indicating a motion state of the vehicle*.

In Kamihira, the target of feedback is not the output value of the neural network itself, but a condition value of a control target which is activated by the output value of the neural network. Therefore, the feedback mechanism of Kamihira is different from the claimed invention.

Additionally, the neural network in Kamihira inputs a throttle property of an electric control throttle, and thus, Kamihira does not disclose or suggest the claimed neural network functioning as a vehicle motion model. Therefore, the neural network in Kamihira does not relate to a vehicle motion model, but to a throttle property.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection since the alleged prior art reference fails to teach or suggest each and every element and feature of Applicant's claimed invention.

B. 35 U.S.C. § 103(a) Rejection over Kamihira, U.S. Pat. Pub. No. 2002/0045958 further in view of Mehrotra, "Elements of Artificial Neural Networks"

The Examiner alleges that Kamihira, U.S. Pat. Pub. No. 2002/0045958, (Kamihira), further in view of Mehrotra, "Elements of the and in Artificial Neural Networks", (Mehrotra), makes obvious the invention of claims 1-3, 5, 7, 9, 11-12 and 14-15.

With respect to independent claims 1, 11 and 12, Applicant submits, however, that neither Kamihira, nor Mehrotra, nor any alleged combination, teaches or suggests,

"plural second recurrent neural networks, each of said second recurrent neural networks formed by connecting second plural nodes such that a second output of a second node is input to another second node in accordance with a second predetermined coupling weight coefficient, comprising a second feedback loop of a second output of at least one

second node, and <u>outputting a second vehicle parameter different from said vehicle parameter output from said first recurrent neural network and indicating said motion state of the vehicle based on said predetermined input information</u>, thereby functioning as said vehicle motion model; and

<u>an optimizing unit for determining an optimum solution of said predetermined coupling weight coefficient of said first recurrent neural network and said second predetermined coupling weight coefficient of said plural second recurrent neural networks based on a learning rule using a hereditary algorithm,</u>

<u>wherein said first recurrent neural network and said plural second recurrent neural networks are mutually connected to each other</u> such that <u>a state variable including a correlation with said vehicle parameter output from said first recurrent neural network is input to each of said plural second recurrent neural networks</u>."

As described above with respect to Applicant's remarks with respect to rejection of independent claim 13, in Fig. 1 of Applicant's invention, the first recurrent neural network corresponds to a yaw rate estimating module 21, and the plural second recurrent neural network corresponds to lateral G estimating module 22, roll estimating module 23, and pitch estimating module 24, respectively.

In Fig. 1 four modules 21 to 24 input to a steering angle, a steering angular velocity, a steering angular acceleration, a steering action force, a vehicle speed, and the vehicle acceleration, as the predetermined input information.

In Fig. 1, the module 21 as the first recurrent neural network outputs the static variable P. The static variable P is input to the modules 22-24 as the second recurrent neural networks. This relation means parallel feedback of the state P as shown below in exemplary

Fig. (A). Claims 1 and 11-13 clearly exclude serial feedback as shown in Fig. (B), below.

Fig. (A) Parallel Feedback

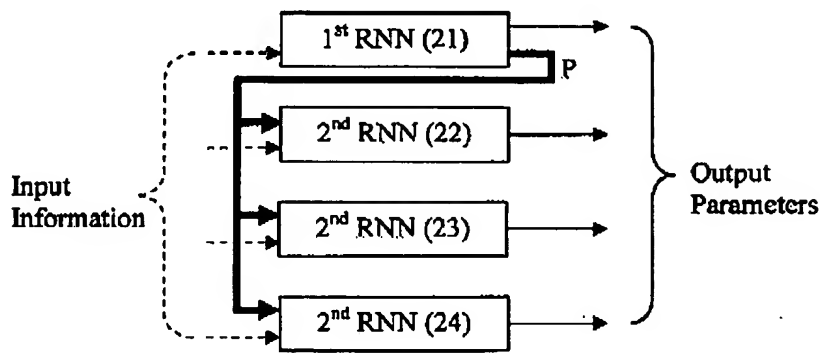
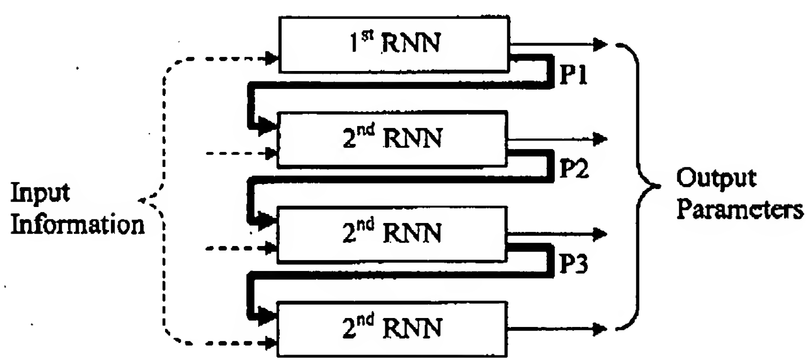


Fig. (B) Serial Feedback



According to Applicant's parallel connection of exemplary Fig. (A), it is possible to control all RNNs synchronously. This effect is described in the specification in detail at page 24, line 9 to page 26, line 5. On the other hand, such effect is not obtained effectively in the serial feedback connection as in Fig. (B), above, because it happens to delay the transfer of the state variable due to its cascading connection. Additionally, at least three RNNs to form the parallel feedback may be employed to accurately produce the output parameters.

Kamihira fails to teach or suggest, "*plural second recurrent neural networks,* ...

<u>outputting a second vehicle parameter different from said vehicle parameter output from said first recurrent neural network</u>."

Kamihira teaches a two alternate loops on the <u>same</u> network of devices, not *<u>a first recurrent neural network</u>* and *<u>plural second recurrent neural networks</u>*.

> A machine 1 is manipulated by a user 6 using a contr a ol module 2 via an interface 4. Performance of the machine 1 is controlled essentially by the control module 2 having an input-output relationship regulated by control parameters. Initial values of the control parameters can be pre-selected, and the machine 1 is activated with the initial values. The performance of the machine 1 is evaluated by the user 6. This <u>feedback loop</u> (the user 6→the interface 4→the control module 2→the machine 1→the user 6) is found in conventional operation. … <u>This second loop</u> (the machine 1→the user 6←→the interface 5←→the parameter module 3→the control module 2→the machine 1) allows the user 6 to customize the control module in real time. (<u>Emphasis added</u>. Paragraph [0032].)

Further, Kamihira fails to teach or suggest, "*<u>an optimizing unit for determining an optimum solution of said predetermined coupling weight coefficient of said first recurrent neural network and said second predetermined coupling weight coefficient of said plural second recurrent neural networks based on a learning rule using a hereditary algorithm</u>*," since Kamihira fails to teach or suggest plural second recurrent narrow networks in addition to a first recurrent neural network.

Furthermore, Kamihira fails to teach or suggest, "*<u>wherein said first recurrent neural network and said plural second recurrent neural networks are mutually connected to each other</u> such that <u>a state variable including a correlation with said vehicle parameter output from said first recurrent neural network is input to each of said plural second recurrent neural networks</u>*," since Kamihira fails to teach or suggest plural second recurrent narrow networks in addition to a first recurrent neural network.

Mehrotra generally describes that recurrent neural networks may contain connections

from output nodes to hidden layers and/or input layer nodes, and they allow interconnections between nodes of the same layer, particularly between the nodes of hidden layers.

Mehrotra fails to teach or suggest, in addition to a first recurrent neural network, "*plural second recurrent neural networks, ... a second output of a second node is input to another second node in accordance with a second predetermined coupling weight coefficient, comprising a second feedback loop of a second output of at least one second node, and outputting a second vehicle parameter different from said vehicle parameter output from said first recurrent neural network and indicating said motion state of the vehicle based on said predetermined input information, thereby functioning as said vehicle motion model; and*

an optimizing unit for determining an optimum solution of said predetermined coupling weight coefficient of said first recurrent neural network and said second predetermined coupling weight coefficient of said plural second recurrent neural networks based on a learning rule using a hereditary algorithm,

wherein said first recurrent neural network and said plural second recurrent neural networks are mutually connected to each other such that a state variable including a correlation with said vehicle parameter output from said first recurrent neural network is input to each of said plural second recurrent neural networks."

Therefore, Mehrotra fails to overcome the deficiencies of Kamihira.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection since the alleged prior art references (alone or in combination) fail to teach or suggest each and every element and feature of Applicant's claimed invention.

C. 35 U.S.C. § 103(a) Rejection over Kamihira, U.S. Pat. Pub. No. 2002/0045958 and Mehrotra, "Elements of Artificial Neural Networks" further in view of Kimoto, U.S. Patent No. 5,579,442 and Minowa, U.S. Patent No. 6,397,140

The Examiner alleges that Kamihira, U.S. Pat. Pub. No. 2002/0045958, (Kamihira), and Mehrotra, "Elements of Artificial Neural Networks," (Mehrotra), further in view of Kimoto, U.S. Patent No. 5,579,442 (Kimoto), and Minowa, U.S. Patent No. 6,397,140, (Minowa), makes obvious the invention of claim 10.

Since Applicant has canceled dependent claim 10, this rejection is now moot.

D. 35 U.S.C. § 103(a) Rejection over Kamihira, U.S. Pat. Pub. No. 2002/0045958 further in view of Kimoto, U.S. Patent No. 5,579,442

The Examiner alleges that Kamihira, U.S. Pat. Pub. No. 2002/0045958, (Kamihira), further in view of Kimoto, U.S. Patent No. 5,579,442, (Kimoto), makes obvious the invention of claims 16-18.

Applicant's dependent claim 16 has been substantively amended such that this rejection as applied to dependent claim 16 is now moot. Additionally, Applicant's dependent claims 17-18 have been canceled, and therefore, this rejection is applied to Applicant's dependent claims 17-18 is now moot.

E. 35 U.S.C. § 103(a) Rejection over Kamihira, U.S. Pat. Pub. No. 2002/0045958 and Kimoto, U.S. Patent No. 5,579,442 further in view of Minowa, U.S. Patent No. 6,397,140

The Examiner alleges that Kamihira, U.S. Pat. Pub. No. 2002/0045958, (Kamihira), and Kimoto, U.S. Patent No. 5,579,442, (Kimoto), further in view of Minowa, U.S. Patent No. 6,397,140, (Minowa), makes obvious the invention of claims 19.

Since Applicant has canceled dependent claim 19, this rejection is now moot.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-4 and 11-16, all of the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: December 5, 2006

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CERTIFICATE OF TRANSMISSION

I certify that I transmitted via facsimile to (571) 273-8300 the enclosed Amendment under 37 C.F.R. § 1.116 to Examiner COUGHLAN, Art Unit 2129, on December 5, 2006.

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